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THE ANODIC PROCESS IN THE ELECTROLYTIC POLISHING OF COPPER IN A SOLUTION OF ORTHOPHOSPHORIC ACID

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In spite of the wide application of electrolytic polishing, it is not yet quite clear what causes a smoothing of the surface. Existing theories are unable to explain satisfactorily all phenomena observed in electrolytic polishing. In addition, chemical transformations occurring in the region around the anode have not been studied. Clarification of the latter point is the purpose of the investigation.

The analytical method has been used for investigating the products of anodic dissolving at various stages of the polishing process. The electrolytic polishing of copper was performed in a solution of orthophosphoric acid (specific gravity 1.55). An anode 3 x 3 centimeters in size was placed between two cathodes. Hydrogen was accumulated on the cathode together with deposits of spongy copper. The polishing process was regulated according to anode potential.

The initial current density was selected to maintain the anode potential in the range of 1.25 - 1.50 volts at the end of polishing, after 10 minutes. Anode and cathode potentials were measured in relation to the calomel electrode. Measuring potentials by the compensation method is difficult, since they change fast in the polishing process. In this case, a suitable calibrated galvanometer was used. A Kaminskiy resistance of 37,000 ohms was connected in series with the galvanometer. The accuracy of galvanometer readings was 0.005 volts which is sufficient for plotting the potential curves.

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The anode and, unavoidable, the part of the electrolyte adjacent to the anode were removed from the bath and dipped into acetone. It was possible to separate the electrolyte (phosphoric acid) from the products of anodic dissolving (copper phosphates), utilizing the ability of acetone to dissolve acids and water and to precipitate mineral salts from mixtures. Analysis of the anodic dissolving products, separated at various stages of polishing, demonstrated that the secondary phosphate is formed in the initial stage and the teritiary phosphate in the terminal stage of the polishing process.

The shape of potential curveg offers and explanation for the mechanism of electrolytic polishing. The surface smoothing is attributed to the exhaustion of electrolyte chemical activity in depressed parts of the anode. On account of the retarded diffusion, the saturation of the near-anode region is attained much more quickly in depressions of the anode than over its protuberances which, principally, are being dissolved. Thermodynamic calculation of static potentials of copper in solutions of its phosphates has been performed. Calculated potentials are in good agreement with those obtained experimentally.

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